

Characteristics in Each Node of the Information Flow Chart (Information Fuser/Personalized):

The World Node:

Everything outside of your particular system, parameters of larger systems that your system fits into should be included

What are the important characteristics of the SVS environment (approach and landing), what affects this environment (that is not related to the SVS)?

Riley states: For enhanced vision, this node would contain parameters for the operational environment and the rest of the airplane, such as engines, the FMS, etc.

- Difficulty of approach
- Difficulty of landing
- Difficult of terrain environment at destination airport
- Traffic situation at destination airport
- Physical state of the engines
- Physical state of the aircraft
- Experience and ability of the pilot
- Pilot experience with this specific approach
- Pilot experience with this specific landing
- Amount of time pilot spent looking out-the-window
- Usability/intuitiveness of displays other than the SVS
- Amount of trust in crew members
- Amount of trust in systems other than the SVS
- Weather
- Degree of time pressure (is aircraft arriving on time, early, or late?)
- Amount of information available from displays other than the SVS
- Glare on displays other than the SVS
- Ceiling visibility at destination airport
- ATC workload
- Functioning/malfunctioning of displays other than the SVS
- Speed of aircraft (too low/high?)
- Altitude of aircraft (too low/high?)

The Human Input Quadrant

Perceive World Node:

The operators access to information about the operational environment through all methods other than the SVS

What affects the pilot's ability to perceive characteristics of the outside environment during takeoff and landing, other than what is being presented on the SVS display?

- Amount of time spent looking out-the-window
- Experience and ability of the pilot
- Pilot experience with this specific approach
- Pilot experience with this specific landing
- Experience using instruments other than the SVS
- Communication with ATC
- Weather conditions at destination airport
- Ceiling visibility at destination airport
- Amount of time spent reading instruments other than the SVS
- Pilots level of confidence in his/her perception of the world
- Current level of SA
- Accuracy of pilots mental model of the environment
- Amount of noise in cockpit
- Amount of collaboration with crew members
- Accuracy of information from displays other than the SVS
- Amount of information available from displays other than the SVS
- Degree of pilot fatigue

Perceive Displays Node:

Refers to the operators act of reading the displays

What affects the pilot's ability to perceive information form the SVS display?

- Glare on SVS
- Physical condition of display surfaces
- Intuitiveness/usability of the SVS
- Display size
- Pictorial scene information density
- Size of symbols/text
- Color of Terrain
- Color of symbols/text
- Degree of display clutter
- Degree of overlay with PFD data
- Auditory vs. visual warning
- Ability to declutter SVS display
- Number of layers in the menu structure
- Number of key presses required to accesss desired information
- Experience using the SVS
- Pilot experience with this specific approach
- Pilot experience with this specific landing
- Experience with this specific airport

- Experience and ability of the pilot
- Location of the SVS display in the cockpit
- FOV currently depicted on SVS display
- Number of obstacles currently in view
- Number of highlighted features currently in view

Infer World State Node:

The operators process of making sense out of the situation and gaining or maintaining situation awareness

What affects the process involved in the pilot's gaining/maintaining situation awareness?

- Inference delay
- Inference error
- Level of pilot mental workload
- Experience and ability of the pilot
- Accuracy of pilots mental model of the SVS
- Pilots level of confidence in his/her perception of the SVS
- Accuracy of pilots mental model of the SVS
- Degree of time pressure (is aircraft arriving on time, early, or late?)
- Amount of time spent viewing the SVS display
- Amount of time spent reading instruments other than the SVS
- Amount of time spent looking out-the-window
- Number of errors in perceiving SVS data
- Difficulty of approach
- Difficulty of landing
- Pilot experience with this specific approach
- Pilot experience with this specific landing
- Degree of pilot fatigue
- Difficulty of terrain environment at destination airport
- Intuitiveness/usability of the SVS
- Amount of information available from displays other than the SVS
- Functioning/malfunctioning of displays other than the SVS
- Amount of noise in cockpit
- Amount of collaboration with crew members
- Number of highlighted features currently in view
- Accuracy of terrain database

Infer Machine State Node:

Refers to the operator's process of understanding what the machine is doing

What affects the pilot's process of understanding what the SVS is doing?

- Degree of redundant coding of SVS data
- Experience and ability of the pilot
- Amount of time spent viewing the SVS display
- Amount of time spent looking out-the-window
- Intuitiveness/usability of the SVS
- Experience using the SVS
- Degree of display clutter
- Functioning/malfunctioning of displays other than the SVS
- Amount of noise in cockpit
- Current level of SA
- Accuracy of pilots mental model of the SVS
- Pilots level of confidence in his/her perception of the SVS
- Level of mental workload
- Number of errors in perceiving SVS data
- Pilots level of confidence in the accuracy of the SVS
- Amount of display cross-checking

World Model Node:

Represents the operators level of understanding about the operational environment

What affects the pilots current mental model of (or awareness of) the SVS environment?

- Current level of SA
- Amount of time spent viewing the SVS display
- Amount of display cross-checking
- Auditory vs. visual warning
- Pictorial scene information density
- Experience and ability of the pilot
- Pilot experience with this specific approach
- Pilot experience with this specific landing
- Amount of time spent looking out-the-window
- Experience using the SVS
- Intuitiveness/usability of the SVS
- Functioning/malfunctioning of displays other than the SVS
- Number of highlighted features currently in view
- Pilots level of confidence in his/her perception of the world
- Accuracy of pilots mental model of the environment
- Degree of pilot fatigue
- Level of mental workload

Machine Model Node:

Represents the operator's current level of understanding about the system, such as current level of readability.

What affects the pilot's current mental model or understanding of the SVS?

- Accuracy of pilots mental model of the SVS
- Experience using the SVS
- Experience and ability of the pilot
- Degree of redundant coding of SVS data
- Degree of display clutter
- Accuracy of terrain database
- Intuitiveness/usability of the SVS
- Amount of trust in the SVS
- Pilot error when using the SVS
- Number of function keys required to access desired information
- Number of layers in the menu structure

Machine's Goals Node:

Represents the operators understanding of the machines current goals and targets

What affects the pilot's ability to understand the goals of the SVS display?

- Experience and ability of the pilot
- Experience using the SVS
- Pilots level of confidence in the accuracy of the SVS
- Accuracy of pilots mental model of the SVS display
- Intuitiveness/usability of the SVS
- Accuracy of terrain database
- Degree of display clutter
- Amount of time spent viewing the SVS display
- Amount of time spent reading instruments other than the SVS
- Amount of time spent looking out-the-window
- Pilot experience with this specific approach
- Pilot experience with this specific landing
- Experience with terrain surrounding destination airport

Predict Machine Behavior Node:

Refers to the operator's anticipation of the next actions to be taken by the machine

What affects the pilot's ability to anticipate the warnings and other behaviors of the SVS display?

- Accuracy of pilots mental model of the environment

- Accuracy of pilots mental model of the SVS
- Accuracy of terrain database
- Amount of display cross-checking
- Amount of time spent looking out-the-window
- Amount of time spent viewing the SVS display
- Experience using the SVS
- Pilots level of confidence in his/her perception of the SVS
- Level of mental workload
- Degree of pilot fatigue
- Current level of SA
- Pilot experience with this specific approach
- Pilot experience with this specific landing
- Experience with terrain surrounding destination airport
- Experience and ability of the pilot
- Accuracy of information from displays other than the SVS
- Accuracy of GPS
- Intuitiveness/usability of the SVS
- Weather conditions at destination airport
- Amount of noise in cockpit
- Lighting conditions in the cockpit
- Glare on SVS

The Human Output Quadrant

Plan Own Action Node:

Refers to the operator's process of deciding what to do next

What affects the appropriateness (or process) of the action chosen by the pilot?

- Accuracy of pilots mental model of the environment
- Accuracy of pilots mental model of the SVS
- Pilots level of confidence in his/her perception of the SVS
- Degree of time pressure (is aircraft arriving on time, early, or late?)
- Current level of SA
- Pilots level of confidence in the accuracy of the SVS
- Experience using the SVS
- Experience and ability of the pilot
- Level of self confidence
- Level of mental workload
- Degree of pilot fatigue
- Weather conditions at destination airport
- Traffic situation at destination airport

- Pilot experience with this specific approach
- Pilot experience with this specific landing
- Amount of time spent looking out-the-window
- Amount of display cross-checking
- Intuitiveness/usability of the SVS
- Pilots level of confidence in his/her perception of the world
- Accuracy of terrain database
- Accuracy of GPS
- Difficulty of terrain environment at destination airport

Operators Goals Node:

Represents the operators actual intentions, and can contain characteristics that are the operators counterparts of the “Operators Goals” and “Machines Goals” nodes on the Machine side of the model

What affects the operator’s actual goals or intentions?

- Accuracy of pilots mental model of the environment
- Current level of SA
- Experience and ability of the pilot
- Weather conditions at destination airport
- Traffic situation at destination airport
- Difficulty of terrain environment at destination airport

Self Model Node:

Refers to the operators assessment of his or her own current abilities or state

What affects the pilot’s ability to assess his/her abilities to deal with the current SVS environment?

- Level of mental workload
- Level of self confidence
- Experience using the SVS
- Level of confidence in the accuracy of the SVS
- Experience and ability of the pilot
- Current level of SA
- Degree of pilot fatigue

Take No Action or Monitor Node:

****This is basically a placeholder, and can itself, be listed as a characteristic**

Provide Information Node:

Represents the process by which the operator enters data into the system or provides other types of information

What affects the pilot's accuracy in providing information data to the SVS (or FMS)?

- Current level of SA
- Experience and ability of the pilot
- Experience using the SVS (or FMS)
- Accuracy of pilots mental model of the environment
- Level of mental workload
- Accuracy of pilots mental model of the SVS
- Intuitiveness/usability of the SVS (or FMS)

Request Information Node:

Represents the process by which the operator enters requests for information, such as calling up new display pages

* It is my understanding that the pilot only has the option of selecting FOV from 4 possibilities. Therefore, this is the only request I am referring to in this section.

What affects the pilot in requesting FOV information from the SVS?

- Pilot preference
- Proximity to the destination airport
- Experience using the SVS
- Experience and ability of the pilot

Command Node:

Represents inputs made by the operator to change the state of the system through a command to automation

**Again, right now, the only thing that I think is selectable (can be changed) is the FOV, therefore, I will refer only to this function in this section

What affects the pilot in commanding the SVS to change FOV?

- Pilot preference
- Proximity to the destination airport
- Experience using the SVS
- Experience and ability of the pilot

Control Node:

Refers to inputs made by the operators through manual control

What affects the pilot in manually entering data concerning flight path into the SVS or FMS?

- Experience and ability of the pilot
- Experience using the SVS (or FMS)
- Level of mental workload
- Intuitiveness/usability of the SVS (or FMS)
- Number of layers in the menu structure

The Machine Input Quadrant**World Sensors Node:**

This node is intended to contain all the potential sources of information coming into the system (should list characteristics of sensors)

How does the SVS receive information, what affects this information (accuracy/quality)?

- Update rate of Terrain database
- Update rate of GPS
- Accuracy of terrain database
- Accuracy of GPS

Control Sensors Node:

Represents all the ways that the operators can put information into the systems, typically through the controls (should list characteristics of controls)

How is information put into the SVS (or FMS), and what affects the accuracy/quality of this information?

- Accuracy of terrain database
- Accuracy of GPS
- Placement of controls
- Tactile feedback from controls
- Layout of controls
- Feedback delay
- Functioning/malfunctioning of hardware/software
- Number of layers in the menu structure
- Number of key presses required to access desired information
- Force requirements

- Precision requirements
- Format restrictions
- Experience using the SVS (or FMS)
- Experience and ability of the pilot
- Current level of SA
- Accuracy of pilots mental model of the environment
- Level of mental workload
- Accuracy of pilots mental model of the SVS
- Intuitiveness/usability of the SVS (FMS)

Machines Goals Node:

Represents the machines current targets, operational parameters, or understanding of the current mission goals.

What affects the ability of the SVS to “understand” which information is relevant to its “role”?

- Accuracy of terrain database
- Accuracy of the GPS
- Limitations of the machines processor
- Functioning/malfunctioning of hardware/software

Operator’s Goals Node

Represents the machines understanding of the operator’s current goals.

***I don’t think that this node applies, since the SVS is not capable of inferring, assisting or understanding the operators goals.*

Infer World State Node:

Represents the machines process of understanding what the current state of the operational environment is, based on information provided to it from its sensors

What affects the processes involved in the SVS gaining/maintaining an understanding of the operational environment?

- Accuracy of terrain database
- Accuracy of GPS
- Update rate of terrain database
- Update rate of GPS
- Functioning/malfunctioning of hardware/software
- Processing time (to display information from terrain database)

Operators Models Node:

Represents internal representation of the human operator used by the machine to draw inferences about the operator's intention and possible future actions. This node would be relevant to a system that can merely be personalized for a particular operator

What affects the ability of the SVS to “understand” what the operator wants personalized? (Note: FOV is the only feature of the SVS that can be personalized)

- Functioning/malfunctioning of hardware/software

World Model Node:

Represents the machines internal representations of the operational environment

What affects the SVS current model of the world?

***Note: these are the same characteristics as listed under “infer world state node”*

- Accuracy of terrain database
- Accuracy of GPS
- Update rate of terrain database
- Update rate of GPS
- Functioning/malfunctioning of hardware/software
- Processing time (to display data from terrain database)

Machine Output Quadrant**Machines Goals Node:**

***See previous “Machines Goals Node” for a list of characteristics*

Construct Displays Node:

Refers to the process of taking information to be sent to the crew and generating the display required to do so. It merely represents the process of converting the information available to the system into display formats for the crew.

What affects the “ability” of the SVS to process information coming into the system and create a display from that information?

- Processing time (to display data from terrain database)
- Limitations of the machines processor
- Functioning/malfunctioning of hardware/software
- Update rate of terrain database
- Update rate of GPS

Displays Node:

Refers to the physical display devices

What affects the display quality of the information presented by the SVS?

- Lighting conditions in the cockpit
- Glare on SVS
- Physical condition of display surfaces

Comprehensive List (Separated by Category):**Environment:**

Accuracy of information from displays other than the SVS
 Altitude of the aircraft (too low/high?)
 Amount of information available from displays other than the SVS
 Amount of noise in cockpit
 ATC workload
 Ceiling visibility at destination airport
 Degree of redundant coding of SVS data
 Degree of time pressure (is aircraft arriving on time, early, or late?)
 Difficulty of approach
 Difficulty of landing
 Difficulty of terrain environment at destination airport
 Functioning/malfunctioning of displays other than the SVS
 Glare on displays other than the SVS
 Lighting conditions in the cockpit
 Physical state of the aircraft
 Physical state of the engines
 Speed of aircraft (too low/high?)
 Traffic situation at destination airport
 Usability/intuitiveness of displays other than the SVS
 Weather conditions at destination airport

Pilot:

Accuracy of pilots mental model of the environment
 Accuracy of pilots mental model of the SVS
 Amount of collaboration with crew members
 Amount of display cross-checking
 Amount of time spent looking out-the-window
 Amount of time spent reading instruments other than the SVS
 Amount of time spent viewing the SVS display
 Amount of trust in crew members
 Amount of trust in SVS
 Amount of trust in systems other than the SVS

Current level of SA
Degree of pilot fatigue
Experience and ability of the pilot
Experience using the SVS
Experience with terrain surrounding destination airport
Inference delay
Inference error
Level of mental workload
Level of self confidence
Number of errors in perceiving SVS data
Pilot error when using the SVS
Pilot experience with this specific approach
Pilot experience with this specific landing
Pilot preference
Pilots level of confidence in his/her perception of the SVS
Pilots level of confidence in his/her perception of the world
Pilots level of confidence in the accuracy of the SVS
Proximity to the destination airport

Machine:

Ability to declutter SVS display
Accuracy of GPS
Accuracy of terrain database
Auditory vs. visual warning
Color of symbols/text
Color of terrain
Degree of display clutter
Degree of overlay with PFD data
Display size
Feedback delay
FOV currently depicted on the SVS display
Functioning/malfunctioning of hardware/software
Glare on SVS
Intuitiveness/usability of the SVS
Layout of controls
Limitations of the machines processor
Location of the SVS display in the cockpit
Number of errors in perceiving SVS data
Number of highlighted features currently in view
Number of key presses required to access desired information
Number of layers in menu structure
Number of obstacles currently in view
Physical condition of display surfaces
Pictorial scene information density
Placement of controls
Processing time (to display data from terrain database)

Size of symbols/text
Tactile feedback from controls
Update rate of GPS
Update rate of terrain database